Water and the Politics of Sustainability Transitions: From Regime Actor Conflicts to System Governance Organizations

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Abstract

This study contributes to the analysis of the politics of sustainability transitions by developing a focus on regime actor conflicts and a processual model for how these conflicts develop and are resolved. In a comparison of water-supply systems in four U.S. cities, we show how conflicts among regime actors and political jurisdictions lead to the formation of system governance organizations (SGOs) that bridge jurisdictional boundaries to manage conflicts over a technological system (TS). SGOs coordinate relations among water utilities and diverse stakeholders to reduce pervasive conflicts, but they can also serve as drivers of improved sustainability. We analyze resistance that can emerge, such as from urban growth coalitions, which limit the capacity of SGOs to drive changes. We develop a four-stage processual model (first-order regime conflicts, SGO formation, sustainability transition expansion, and second-order regime conflicts) that opens research in the politics of transitions to the dynamic of regime actor conflicts and provides the basis for generalizations about the causes of SGO formation and their effects on the governance of TSs such as water-supply infrastructure. Policy implications regarding how to improve political support for SGO sustainability efforts are also discussed.

Keywords: Politics, sustainability transitions, regional governance, water conservation

1. Introduction

One of the most pressing issues for the study of sustainability and environmental policy is securing good quality and quantity of freshwater supply. As demand on the world's resources has grown, water-supply organizations (WSOs) throughout the world have faced the problem of adapting growth in demand to restrictions in supply. One approach to the solution is to seek out new water resources, such as by building new reservoirs and by accessing new groundwater sources. Although this approach benefits WSOs by expanding revenue and infrastructure, it can lead to conflicts with other actors who claim to have rights of access to the same water. Another approach is to seek a more fundamental sustainability transition in the water-supply system by reducing water demand. However, this approach also can trigger opposition, such as from consumers who did not like new pricing policies or water-use restrictions. Thus, the study of sustainability and the water-supply system can be a good site for developing general knowledge about the politics of sustainability transitions, and the general knowledge can be used to develop policy implications for the governance of water-supply systems.

This study contributes to the practical problem of understanding the conditions under which WSOs solve problems of water-supply while also addressing sustainability concerns, but in doing so it also makes a theoretical contribution to the emerging literature on the politics of transitions (Avelino, Grin, Pel, & Jhagroe, 2016). Much of this literature focuses on the relationship between challengers and incumbents in an industrial field, and much of it focuses on this relationship at the national scale. More recent research has begun to draw attention to relations among incumbent or regime actors (Bergek et al. 2015), and some of the researchers have also pointed out the need to include other levels of spatial scale than the national level (e.g., Raven, Schot, & Berkhout, 2012; Späth & Rohracher, 2012; Truffer & Coenen, 2016). Consistent with these newer approaches, we advance the analysis of sustainability transitions by examining how efforts to expand water-conservation policies (WCPs) is connected with conflicts among regime actors that seek to gain access to limited natural resources, and we do so with a focus on the regional (subnational) scale.

Relations among regime actors do not necessarily involve conflict; however, when there are scarce natural resources, conflicts can emerge. Water-supply systems provide a good example of a type of technological system (TS) where these conflicts are endemic, especially in areas of the world where freshwater resources are stressed or limited. Thus, in this study we focus on water-supply systems, and we base the analysis on detailed research in four U.S. metropolitan areas where conflicts have been prominent. We show how deep and seemingly intractable conflicts develop, and we then show how the conflicts are resolved. In doing so, we develop the politics of transitions literature by drawing attention to how conflicts among regime actors leads to new organizations that in turn can affect sustainability transitions. These "system governance organizations" (SGOs), or specialized governmental units that manage TSs such as water-supply infrastructure, serve to bridge jurisdictional boundaries and to adjudicate conflicts. In addition to advancing the literature on the politics of transitions by bringing a sharper focus to the relations among regime actors, we also develop a processual model of the conditions for the formation of SGOs and their effects on the transition of water-supply systems toward higher levels of sustainability. This approach to the politics of transitions literature also generates some policy implications for those attempting to develop and strengthen SGOs.

2.0 Background Concepts and Frameworks

2.1 The Politics of Sustainability Transitions

The term "technological system" (TS) is used here to refer to a network of material objects and human institutions that include three dimensions: environmental (natural resources and physical landscapes), sociotechnical (organizations, actors, infrastructures, and technologies), and cultural (symbolic systems of cognitive and normative categories, including rules and regulations). Examples include a transportation system, an electricity system, or a water-supply system. Consistent with the literature on transition studies (e.g., Geels 2014), we use the term “regime” to mean a relatively stable configuration of TS elements. Much of the literature on transitions has focused on the niche-regime relationship, with the idea that system-changing innovations are developed by “niche” actors. These actors may appear within the research-and-development units of regime actors, or they may appear in civil society, entrepreneurial, academic, or governmental organizations. Generally, the innovations develop in a “protective space” until they are able to compete in markets (Smith & Raven, 2012). Where the regime actors perceive the innovations as a threat, the niche-regime relationship becomes a challenger-incumbent relationship. Although the innovations of the niche actors may also be compatible with the regime, conflicts can develop within an industrial field between challengers and incumbents over the direction of a TS. These conflicts are especially acute when there are political and scientific reasons supporting a transition of the TS toward greater sustainability, but the regime actors are threatened by the changes.

A transition is a fundamental change in the configuration of the elements of the TS, and a sustainability transition is one that significantly improves the environmental effects of a TS. The concept of sustainability is understood here as an ideal steady state that occurs when withdrawals of the TS from the natural environment are less than the capacity of the TS to replenish them, and the waste injected into the environment from the TS is below the environment’s limits to process the wastes (Daly 1996). The analysis of sustainability can be operationalized through various metrics. We will focus especially on the development of WCPs in cities as one factor that can contribute to a transition toward a steady-state configuration of a water-supply system. Although our focus is on sustainability, issues of fairness and equity will also appear in the case studies that follow. They are often represented by actors in subordinate positions in the political field, such as social movement and civil society organizations. The politics of transitions can become interwoven with conflicts over equity, fairness, and justice.

As the literature on transitions developed, several researchers drew attention to the need to have a more systematic analysis of power and politics (e.g., Meadowcroft, 2011: Walker & Shove, 2007). In response, researchers developed theoretical frameworks for the analysis of power and agency (Avelino & Rotmans, 2009; Avelino & Wittmayer, 2016), of the institutional dimensions of industry and the state (Feunfschilling & Truffer, 2014, 2016; Turnheim & Geels, 2013), of structuration processes and trial-and-error learning (Grin 2012), and of reflexive and democratic governance problems associated with transition management (e.g., Voss, Smith, & Grin, 2009).

To date empirical research on the politics of transitions has developed insights into strategies and processes of niche-regime actor relations. One approach in the literature examines how regime actors incorporate and transform innovations to make them compatible with the regime, and in some cases regime actors resist policy initiatives that appear threatening. Regime actor strategies include mobilizing resources, shaping political discourse through appropriate framings in the media, innovation of system-compatible technologies, and shaping the structure of institutional power (Geels 2014). Regime actors may also attempt to shape technological standards to their benefit (Smink, Hekkert, & Negro, 2015), and they may work to reverse policies already in place that favor niche development such as support for solar and wind energy (Hess, 2016a; Lauber & Jacobsson, 2016). In cases where governments have attempted to implement transition policies, such as for the attempted transition of the Dutch energy system, regime actors have dominated the process (e.g., Hendricks, 2008, Kern & Smith, 2008).

Another strand of research in the politics of transitions draws attentions to the strategies of niche actors and transition coalitions. Smith and Raven (2012) described three conditions for the success of niche expansion: shielding niches from the selection environment, nurturing the niche’s sociotechnical and/or economic performance, and empowering niches by adjusting their relationship to mainstream selection environments. Along the same lines, Elzen, Geels, Leeuwis, and van Mierlo (2011) argued that in order for niche actors to gain policy support, they must successfully place normative pressure on regime actors and states (such as by social movement mobilization) but also have technological and economic readiness when political and economic opportunities open. As with social movements in general, niche actors and technologies often undergo a degree of cooptation along with the transformation of the systems, and indeed there is often a complicated dialectical relationship (Pel, 2016).

A third strand of the politics of transitions literature examines how niche-regime conflicts become overlaid with conflicts among political parties in governments. In general, when conservative governments come into power, they have tended to weaken or reverse the pro-environmental initiatives of labor-left-green coalitions. These divisions are especially polarized in the developed Anglophone countries, but they also appear in continental Europe (e.g., Lauber & Jacobsson, 2016; Markard, Suter, & Ingold, 2016; Verhees, Raven, Veraart, Smith, & Kern, 2013). However, studies of transition policy development and retrenchment often go beyond this basic left-right alignment. Some researchers have also shown that divisions among regime actors and within conservative coalitions can weaken efforts to reverse sustainability policies (Markard, Suter, & Ingold, 2016). Furthermore, transition coalitions can sometimes draw on support from regime actors from countervailing industrial groups, which may form alliances with niche-oriented transition coalitions (Hess 2016b).

In summary, most of the work to date on the politics of transitions has focused on the dominant role of regime actors in transition processes and their strategies of resistance, and it has also drawn attention to the processes involved in developing niches and gaining support through coalition politics. This project advances the study of the politics of transitions by shifting attention from the niche-regime relationship to conflicts among regime actors and to the attempted settlement of the conflicts through the creation of new governance organizations.

2.2 A Processual Model of SGO Formation

There are two main types of relations among regime actors. The “same type” relationship involves relations among actors associated with similar TSs located in geographical proximity that may interact. For example, a WSO for one metropolitan area may agree to a transfer of water from another WSO, or two WSOs may engage in conflict over rights of access to surface water or groundwater. The “different type” relationship involves regime actors from industries that are connected to the TS, either involving inputs into or outputs from the TS. For example, rural recreation and agricultural industries also utilize the water upstream and downstream from the WSO, and likewise customers of the WSO, such as the urban landscaping and gardening industry, have a concern with adequate water supply. The relations among regime actors may involve cooperation, conflict, or both. Cooperative relations can be the basis for the formation of dense networks that may lead to the formation of new governance organizations (Hawkins, HU, & Feiock, 2016), but protracted conflicts that cannot be managed within existing political organizations may also lead to the formation of SGOs. In turn, these SGOs can affect the pace of a sustainability transition within a water-supply system.

In this study, we develop and apply a processual model that links interactions among both types of regime actors to the politics of transitions and the formation of SGOs. We build on research on relations among TSs (e.g., Bergek et al., 2015), but we focus much more on political conflict among regime actors. Likewise, we draw on processual work on transitions as institutionalization (e.g., Feunfschilling & Truffer 2014, 2016) or structuration (e.g., Grin, 2012), but we focus less on institutional logics or trial-and-error learning and more on how attempts to settle conflicts leads to new forms of system governance. There is also a relevant neighboring literature on the management of natural resources, of which the most relevant is work on river-basin governance (e.g., Huitema and Meijerink 2014, Schlager and Bloomquist 2008). Although the study of river-basin organizations is at a higher scale and with a broader scope than that of metropolitan water-supply systems, the literature has also established how the formation and development of regional governance organizations are deeply political processes. Furthermore, as for the SGOs in our study, river-basin organizations can emerge from a mix of bottom-up efforts to resolve conflicts and from decisions by state-level or federal governments to impose resolutions, and the conflicts and politics persist after the organizations are established. Thus, the neighboring literature is broadly consistent with our processual politics approach.

We investigate the following stages in a processual model:

1. First-order Regime Conflicts. Coalitions of regime actors (incumbents in the TS and their customers and suppliers) seek continuing growth of a TS in order to feed a pattern of capital accumulation and economic growth. The regime organizations of a TS (in our case, the WSOs) respond to the demand for growth by engaging in expansionary strategies. These strategies can lead to resistance from other regime organizations, which may be of the same type or different type.
2. SGO Formation. Conflicts can become protracted and lead to long-term disputes, including litigation. Higher-level governmental organizations will then offer to intervene or be asked to intervene. If existing governmental units are inadequate for conflict resolution and if scale-sensitive institutions are needed (Padt, Opdam, Polman, & Termeer, 2014), SGOs will be created.
3. Sustainability Transition. Where natural resources and coupled human-natural systems are salient in the conflicts (as in the case of water-supply systems), the SGO mission may include goals of improving the sustainability of the TS, and the SGO may contribute to efforts to make the TS more sustainable. These efforts may enhance the empowerment of niche actors (Smith and Raven, 2012) and their associated political coalitions.
4. Second-order Regime Conflicts. Some regime actors of the TS may attempt to resist the sustainability initiatives; however, resistance may also come from regime actors associated with other industries that are negatively affected by attempts to deepen the sustainability transition. These patterns of resistance may lead to additional reforms of the SGO. Thus, the process is iterative.

The processual model has broad theoretical significance because it draws attention to the relatively unrecognized interaction among regime organizations, rather than the niche-regime conflict per se, as a driver of a sustainability transition. We show how the formation of SGOs can be an outcome of conflicts among actors associated with regime organizations and can affect the pace and direction of the transition of the focal regime. Although we focus on case studies of water supply, the processual model has potential generalizability well beyond the geographical and industrial scope of this study. Our broader goal is to develop a better understanding of the causal pathways that both drive and block transitions and to analyze those pathways in an integrated way that includes conflicts among regime actors under the purview of the politics of transitions and the role of SGOs in sustainability transitions.

3. Methods

There are various ways to measure the sustainability of a water-supply system. One approach is to focus on the source of water, such as a safe yield for groundwater or the maintenance of traditional downstream flow levels for downstream users. Although we mention this approach when relevant, we focus here on two other approaches: per capita water consumption and water policy development. The former can give a sense of the comparative efficiency of a water-supply system; however, it is not a good measure of water conservation because per capita consumption is related to climatic conditions, water pricing, and the mix of residential and industrial customers in a jurisdiction. We prefer and will use a measure of WCP development that we constructed from a data set of 200 cities (197 cities after excluding three for insufficient data). The measure was based on the evaluation of each city for 79 observations of WCPs and related WSO system features. It is the most comprehensive measure of WCP adoption at the urban level in the U.S. (for details, see Hess et al. 2017).

From the data set, four cities were selected for more detailed ethnographic interviews in a 2x2 design (aridity and level of WCP adoption). We use aridity because our previous research indicates that WCP adoption tends to be higher in drier, Western states, and it is necessary to include it as a control in any comparative analysis. We use WCP adoption as the variable of interest, in effect the dependent variable. Thus, we sample two cities from the relatively wetter, Eastern part of the country (Atlanta, Georgia, with a lower rank on WCPs, and Tampa, Florida, with a higher rank) and two from the relatively drier, Western part of the country (Phoenix, Arizona, with a lower rank, and San Antonio, Texas, with a higher rank). These cities have a history of water stress, and they also have high population growth that has caused WSOs to seek new sources and to engage in water conservation. The four cities all have some type of SGO that has been developed to manage water-supply issues.

To assemble the case studies, we relied on interviews and on primary and secondary source documentation on the history of the WSOs and SGOs. These four cities are known for extensive and complex histories of water supply, and there is a good secondary literature. Brown also conducted interviews by telephone with actors in five broad categories of organizations in the four cities: environmental and community organizations, WSOs, agricultural and rural organizations, the business organizations (e.g., real estate and landscaping companies and general business associations), and universities. The forty-six interviews were transcribed and then placed in a single document, which was over 170,000 words in length. Coding was conducted based on a variety of categories that served various projects. Coding categories included the main types of WCPs (e.g., rebates, mandates, water recycling, and pricing), water sources (reservoirs, desalination, aquifers, and pipelines), and main actors (water utilities, landscape industries, environmentalists, state government agencies, scientists, and SGOs). These codes allowed us to identify systematically conflicts over types of WCPs and water sources and who was involved in the conflicts. Interviewee identity was kept confidential.

4. Results

4.1 Atlanta

Because Atlanta was built on ridges as a railroad hub, it lacks access to a large river system that is typical of most other large inland cities in the U.S. Its primary water source is surface water from Lake Lanier in the Apalachicola-Chattahoochee-Flint River Basin. The city is growing rapidly, and water demand between 2015 and 2030 could increase by as much as 100% (Missimer, 2014). The region is subject to recurrent droughts, and it is widely recognized that dependence on Lake Lanier is not adequate.

First-order Regime Conflicts. The primary conflict in the Atlanta case is with regime actors in downstream industries and TSs, who were supported by their state governments. The U.S. federal government's Army Corps of Engineers governs Atlanta's main water source, Lake Lanier, which was completed in 1957 and also provides hydroelectric power for the region. In response to the Atlanta area's increasing demand for water and to a series of drought years during the 1980s, the Corps proposed in 1989 that 20% of the Chattahoochee River water could be used for drinking water. In response, the states of Georgia and Florida filed lawsuits in 1990 against the state of Georgia, where Atlanta is located, and sought to have the Army Corps prevent the local consumption of water from Lakes Lanier, Carters, and Allatoona (Missimer, 2014). The potential loss of downstream flow threatened to have economic impacts on agriculture, fishing, recreation, and electric power.

In 1997 the three states signed two compacts, the Apalachicola-Chattahoochee-Flint River Compact and the Alabama-Coosa-Tallapoosa Compact (Lathrop, 2009). However, the states continued to have conflicts, and the compacts lapsed in 2003 and 2004. In 2009, the U.S. District Court ruled that the three states had three years to work out an agreement, and if they failed to do so, the Army Corps would cut off water supplies from Lake Lanier. To the relief of Georgians, in 2011 the United States Court of Appeals for the Eleventh Circuit ordered the Army Corps to develop a plan to allocate Lake Lanier's water that included drinking water for Atlanta. Although the litigation was still in process in 2017, the state of Georgia was in a better position than after the 2009 ruling, and concern with water supply had eased considerably. Some of the interviewees commented that the 2011 decision reduced the political will for more intensive water conservation as well as for more reservoir construction.

SGO Formation. Although some watershed areas in the U.S. have interstate SGOs, there is no interstate SGO in this case. The litigation is not yet resolved, and to some degree the Army Corps has provided some of the adjudication role associated with SGOs elsewhere. In the absence of an interstate SGO, the Atlanta area has developed an SGO with more limited planning responsibilities. In 2001 the state government authorized a regional SGO under the Metropolitan North Georgia Water Planning District Act (Senate Bill 130). Interviewees pointed to a convergence of factors that led to the district's creation: the concern with a precarious water supply as a result of the tri-state water war, a long-term pattern of occasional multiyear droughts, and federal court decrees in 1998 and 1999 that required the city to resolve its defective wastewater system that mixed sanitary sewerage and stormwater. Furthermore, in 2000 an electric power utility had filed a lawsuit arguing that the use of Lake Lanier for drinking water was causing the utility to charge higher prices (Borden, 2014). Thus, conflicts between the two types of regime actors (utilities and WSOs) over the quality and quantity of water released into the watershed were a significant driver of the creation of the district. However, concerns with lack of supply, exacerbated by drought conditions and city's rapid population growth, also played a role. The district's mandate reflected this convergence of factors with its multiple goals of managing supply, conservation, the watershed, and wastewater systems. The district has a governing board comprised of elected officials and citizen representatives; has a geographical scope that covers over 90 cities and 15 counties; and is staffed by the Atlanta Regional Commission, the regional planning agency. Plans are enforced by the state government, which reviews utility permit renewals for compliance with district plans.

Sustainability Transition. Because the district's mandate includes water conservation, the SGO has contributed to WCP development. Starting in 2003, the Metro District implemented a range of water conservation measures for utilities in its jurisdiction. Increasing block-rate pricing was one of the more notable achievements, and the state government's 2010 Water Stewardship Act mandated additional conservation measures statewide such as high-efficiency fixtures, requirements for leak detection, and limits on outdoor irrigation.

With respect to sustainability measures, Atlanta ranks 49 out of 197 cities in our comprehensive measure of WCP adoption. An interviewee knowledgeable about the WSO estimated that reduction of water consumption was over 30% from the benchmark of 201 gpcpd (gallons per capita per day) in 2000 to the time of the interview in 2016. As a representative of the business community commented in an interview, "When you move another million people into your region and you are still down 20 percent in your water use, I think that is a pretty good barometer that the work you are doing is effective."

Second-order Regime Conflicts. Interviewees noted substantial resistance from the landscaping industries, which strongly opposed outdoor watering restrictions, and some resistance from the real estate industry. The SGO has also suffered from underfunding (Borden 2014), and one interviewee complained that the state government agency that enforced planning goals through WSO permitting was understaffed, adding that "the audits that ensure that compliance are not especially robust." In the report "Filling the Water Gap," the Chattahoochee Riverkeeper (2012) developed multiple recommendations about how the city and region could improve their water conservation efforts and save millions of gallons of water per day.

Although environmentalists such as American Rivers (2008) argued that proposals to increase water conservation are less expensive alternatives to reservoir construction, in 2011 the state government embraced reservoir construction when it approved Senate Bill 122, the Georgia Public/Private Water Supply Act of 2011. Environmentalists whom we interviewed indicated that the growth coalitions and WSO regime actors preferred a strategy of building new reservoirs over more extensive WCP implementation. However, the state government, the Metro District, and local communities subsequently showed signs of shifting away from a reservoir-based acquisition strategy. Interviewees suggested that one factor was growing resistance from the Army Corps to new reservoir applications, largely because re-estimates of population projections suggested lower demand growth. In addition, there was some litigation against reservoir construction plans, and communities in the surrounding region were finding that costs were excessive. As an interviewee associated with a regional environmental organization commented, "The Metro District is in a weird point where they are acknowledging something we have been saying all along, which is that your population can grow, and your water supply doesn't have to grow, if you do all these conservation and efficiency things." In summary, the SGO in Atlanta has played an important role in bringing about a higher level of WCPs, but the general strategic conflict over enhanced water conservation as preferable to building new reservoirs remained contested.

4.2 Tampa

The Tampa Bay area is supplied by regional groundwater wells (about 60-70% of the water supply) with the remainder from regional rivers and a desalination plant. The main constraint on the water supply is the limited capacity of groundwater and the potential for withdrawal to result in sinkholes, depletion of lakes, and saltwater intrusion. River water is available in the region, but it is of poorer quality. The Tampa case is interesting because it shows how SGO formation may not immediately resolve the TS conflicts, and a new cycle of conflict may follow. Thus, the case shows how a processual model involves loops.

First-order Regime Conflicts. Because the City of St. Petersburg lies on a narrow peninsula that lacks adequate water supplies for the city's population, it must secure water supplies from other areas. By the 1970s Pinellas County, where St. Petersburgh is located, began buying land and developing wells in the other two counties of the metropolitan area. Although the initial phase of water acquisition was cooperative and contractual, the development of wellfields led to the degradation of the lakes and wetlands and to the loss of water supplies in some rural areas. In turn, actors associated with the rural agricultural regime showed increasing resistance to the expansion of the St. Petersburg water-supply regime.

SGO Formation. In 1974 the state legislature created the West Coast Regional Water Supply Authority (or "West Coast") to resolve conflicts and to manage water supply at a regional level. In addition, the state government expanded the mission of another SGO, the Southwest Florida Water Management District (SWFWMD, pronounced "swift mud"). SWFWMD encompasses all or parts of sixteen counties in the western coastal region of the state, and like other water management districts in the state, its board is appointed by the governor. Established in 1961 in the wake of Hurricane Donna, the original mission of SWFWMD was to supervise flood control projects. In 1972 the mission was expanded under the Florida Water Resources Act (Chapter 373, Florida Statutes), which included planning requirements and permitting rules for both groundwater and surface water.

More First-Order Regimes Conflicts. Even with one new SGO and an expanded mission for another SGO, water management problems continued to plague the area. Both SWFWMD and West Coast wanted the area WSOs to shift to more conservation, but there was resistance to the goal, and groundwater withdrawal continued (Dedekorkut, 2005). Citizens in the more rural Pasco County continued to complain about the environmental effects of groundwater pumping that benefited their neighbors in the cities, but the urban growth coalitions and the regime actors in the local WSOs advocated continued access to rural groundwater (Rand 2003). During the early 1990s SWFWMD issued increasingly stringent rules to reduce consumption based on the effects on residential wells and local ecosystems, and in 1994 it issued an emergency order to reduce groundwater withdrawals. The SGO's intervention led to an intense legal battle that pitted SWFWMD against West Coast, the City of St. Petersburg, and Pinellas County (Dedekorkut, 2005). A coalition of over 3,000 property owners also launched a class-action lawsuit against overpumping, and in turn they faced a counter-suit from Pinellas County that forced them to settle.

SGO Reform. In response to the ongoing conflict, both SGOs underwent substantial changes. In 1996 the state legislature approved the Water Resources Act to require SWFWMD to establish minimum water levels in the region and to determine the impact of pumping versus drought. In 1998 West Coast became Tampa Bay Water, with a governing board that was set up to have a balanced representation from the three counties. The new organization had control over water development and well fields in the region, and it offered the same rates for all customers (Dedekorkut, 2005).

Sustainability Transition. SWFWMD regulates groundwater based on the goals of safe yield and of slowing the development of saltwater intrusion. Although these actions do not directly affect WCPs, they have created favorable conditions for WCP development. SWFWMD has also directly implemented water conservation rules such as limitations on water waste in outdoor irrigation systems (Florida Code 40D-22.201). The SGO also provides assistance to WSOs for leak repair programs and for water conservation programs such as toilet rebates. Tampa Bay Water works with member governments on WCPs mainly through information dissemination, but the regionalization of water supply made it possible to shift supply among different wellfields. The change reduced overpumping and helped transition the whole water-supply system toward a goal of safe yield.

With respect to sustainability measures, Tampa was ranked twentieth out of 197 cities on our comprehensive measure of WCP adoption, and it was the second highest city (after Miami) in the wetter, Eastern part of the U.S. In Pinellas County, where St. Petersburgh is located, the utility reduced total water consumption from 153 gpcpd in 1990 to 67 gpcpd in 2014-2015, and the City of Tampa's Water Department reported a decrease from 181 gpcpd in 1989 to 112 gpcpd in 2014 (Tampa Bay Water, 2016).

Second-order Regime Conflict. Our interviews indicated that there was fairly high acceptance of the policies of the SGOs. This is partly because there was a strong collective memory of the "Tampa Bay water wars" that lasted into the 1990s, and the memory included recognition of the need for SGOs. There was also recognition that the local ecosystem had been badly damaged by excessive groundwater withdrawal, and recovery was now evident. As one SGO representative commented, "A lot of those areas that were damaged, especially the lakes, have recovered over time. So the levels of those lakes are going back to historic averages." However, the interviewees noted mobilizations by the landscaping industry against some WCPs, and they also noted that the general mentality of real estate developers tended to weaken support for a higher level of water conservation. Nevertheless, these regime actors from connected industries lacked the power to make fundamental changes in water acquisition policy, such as a return to excessive groundwater withdrawal. In summary, in the Tampa case the pair of strong SGOs, and their legitimacy in the wake of the collective memory of the water wars, has led to fairly high acceptance and progress in measures of WCP development and per capita consumption.

4.3 Phoenix

Phoenix is a desert city that was constructed on the ruins of the extensive irrigation system of the Hohokam civilization, which abandoned the region after 1375. Archaeologists are not completely sure of the reasons, but the causes are presumed to include periodic flooding and droughts. About half of the city's water comes from the Salt River Project, a regional system of surface and groundwater supply from the Salt River and Verde River watersheds, and half comes from the Central Arizona Project, which brings water from the Colorado River via a canal system.

First-Order Regime Conflicts. The Salt River Project began when central Arizona landowners pledged their land as collateral for the construction of public works projects under the National Reclamation Act of 1902. The first hydroelectric facility and water-supply system in this region was completed in 1911, and the Salt River Project became a major provider of electricity and water for the Phoenix area. As Phoenix and other cities in the metropolitan area expanded, they bought land that had agricultural rights, thereby transferring water from the agricultural to urban uses. Because suburban residential use was generally lower than agricultural use for the same area of land, these transfers also reduced water demand. These first interactions of the agricultural and urban water-supply systems were cooperative and accomplished through contracts.

However, by the 1960s the state began to search for new water sources to address rapid growth. Extensive groundwater pumping had led to land subsidence, and supplies from the Salt and Verde Rivers were limited. The Colorado River was the closest alternative source of water, but conflict among the different states adjoining the river had resulted in a federal government settlement long before the Phoenix area reached the conclusion that more water was needed. In 1922 the states in the watershed had signed the Colorado River Compact, and under the federal government's 1928 Boulder Canyon Project Act, water from the lower Colorado River was allocated as follows: 4.4 million AFY (acre-feet per year) to California, 2.8 million AFY to Arizona, and .3 AFY to Nevada. Arizona was unhappy with the division, and the disputes were not settled until 1963, when the U.S. Supreme Court confirmed the allocation in the ruling on Arizona v. California. A treaty with Mexico in 1944 addressed the primary output conflicts by guaranteeing the neighboring country downstream rights of 1.5 million AFY.

SGO Formation. Arizona had not used its full allotment of the Colorado River water, and the state government sought approval for a canal to central Arizona in order to bring the water to the large and rapidly growing metropolitan areas. The U.S. government's 1968 Colorado River Basin Project Act authorized the construction of the Central Arizona Project, a canal that would bring water to the Phoenix area and beyond. However, the federal government stipulated that the state must reduce its excessive groundwater withdrawals. The resulting Arizona Groundwater Management Act of 1980 established a system of water governance led by the Arizona Department of Water Resources with the goal of achieving safe yield by 2025. The law also created SGOs to regulate groundwater withdrawal. Where water withdrawal was heaviest, the state government set up regional Active Management Areas (AMAs) under the Arizona Department of Water Resources. The AMAs limit and measure groundwater withdrawals, govern the expansion of irrigated agriculture, provide demand-management goals, require new developments to have access to water supplies, and pursue the goal of safe yield. The Phoenix AMA covers an area surrounding the Phoenix area and includes several WSOs in addition to the City of Phoenix Water Services Department, which delivers water to approximately 1.5 million customers.

The AMAs regulate groundwater withdrawal, and they have the power to restrict new real estate development. One of the requirements of the groundwater management law was that new real estate or industry developments in an AMA must demonstrate that they have an assured supply of water for 100 years. This requirement can be met by a permit from a city for water supply, the retirement of agricultural water rights based on land acquisition, or offsets in the form of contributions to the Central Arizona Groundwater Replenishment District. The latter provides groundwater storage of water supplied by the Central Arizona Project. The solution is based on unrealistic projections of a long-term availability of water from the Central Arizona Project for aquifer recharging (Hirt, Gustafson, & Larson, 2008). Moreover, it does not motivate the WSOs to engage in water conservation.

Sustainability Transition. Interviewees stated that the City of Phoenix tends not to use mandates for its WCPs, instead, it prefers education and voluntary programs. One study indicated that between 60% and 75% of residential water is used outdoors to maintain nonnative, water-intensive landscapes and swimming pools (Balling, Gober, & Jones, 2008). However, the city has invested heavily in water recycling, including the exchange of reclaimed water for higher-quality groundwater that otherwise would be used by agriculture. It has also invested in leak repair of the city's water-supply lines (City of Phoenix, 2011).

With respect to sustainability metrics in the Phoenix area, total per capita water consumption declined from approximately 250 gpcpd in 1990 to 170 gpcpd in 2014, but the latter consumption level was still relatively high in comparison with other cities in this study (City of Phoenix, 2016). Likewise, the city of Phoenix is ranked at 57 out of 197 cities in our comprehensive measure of WCP adoption, a lower-than-expected-score, especially for a city in an arid climate. (In the multivariate models for all 197 cities, which use a range of variables to predict each city's score for WCP adoption, the score for Phoenix is also lower than predicted; for more details, see Gilligan et al. 2017). The relatively low level of WCP adoption is due to several factors, among them the city's conservative political culture (which opposes WCPs that involve mandates or requirements), the good access to the Colorado River water, and the relatively weak role of SGOs.

Second-order Regime Conflicts. In addition to the access to freshwater from the Central Arizona Project, the relative weakness of the AMA in the Phoenix area has contributed to the poor performance on WCPs and per capita consumption. The Arizona Department of Water Resources and the Phoenix AMA have suffered ongoing resistance to their attempts to implement demand-management goals (Hirt et al., 2008; Larson, Gustafson, & Hirt, 2009). For example, by 1989 approximately 60% of the providers of the Phoenix AMA were not in compliance. Resistance from WSOs and agricultural organizations was strong, and the organizations and state government faced ongoing litigation. The state government department backed down on its goals, exempted many of the smaller providers, and developed a voluntary alternative to the per capita per day program goals. Larsen, Gustafson, and Hirt (2009) conclude that the weakness of the SGOs reflects the lack of support from the state government and a growth-oriented political culture that opposes government regulation, and our interviews confirm this interpretation. The result is that the overdraft on aquifers continued to grow while WCPs remain much weaker than in many other large cities in arid regions of the country. As an environmentalist commented in one of our interviews, "There are no incentives, there are no penalties, there is no assistance, and so typically government entities have not made aggressive steps to comply." Additional bills were under consideration in the state legislature to further weaken the AMAs. Because these SGOs were imposed by the federal government and did not solve local TS conflicts, they have relatively weak political support.

In summary, one would expect that a metropolitan area in the middle of the Sonoran Desert would have a very degree of WCP adoption, but as long as the water continues to flow from the Colorado River, the region is not especially water stressed. It is as if the city is located next to a large river, albeit an artificial river that flows uphill. The SGO lacks political support and has suffered ongoing erosion of its authority.

4.4 San Antonio

The primary source of potable water in San Antonio comes from the Edwards Aquifer. Because there are limits on withdrawals from the aquifer, the city pays close attention to the level of the aquifer and has attempted to diversity its water sources. The aquifer was 70% of the city's supply in 2000 and is projected to decline to 32% in 2030, but because some of this decline includes banked water from the aquifer when the flow is adequate, the projected number may overestimate the extent of diversification.

First-order Regime Conflict. Because groundwater law in Texas is subject to the rule of capture (actors can withdraw as much water as they can use), aquifer depletion is a problem in some areas of the state. In the San Antonio region intense conflicts emerged among rural upstream users, urban users, environmentalists, the recreation industry, and downstream users who wanted to ensure a stable flow of water. For example, the Guadalupe-Blanco River Authority wanted to see water withdrawals regulated because it was concerned that during a drought the springs would dry up and affect downstream water availability. However, the goal of limiting withdrawals from the Edwards Aquifer was not realized until after 1991, when a federal court ruled that takings of species could occur if the withdrawals from the aquifer were to cause Comal and San Marcos Springs to dry up.

SGO Formation. The state government had already created a network of SGOs to manage various aspects of water supply and quality throughout the state: regional planning groups (Ashworth and Jensen 2011); a water bank to manage the transfer of water rights; river authorities for the management of surface water; and groundwater management areas, each of which includes several groundwater conservation districts (Kaiser, 2011). Because the 1991 federal court decision required additional management of the aquifer, the state legislature decided to avoid federal intervention and created the Edwards Aquifer Authority in 1993 (Senate Bill 1477). The new SGO supported a system of tradeable permits (Eckhardt, 2015; Votteler, 2004, 2011).

More Conflicts. At first, the Edwards Aquifer Authority did not resolve conflicts. Initial applications for withdrawals from the aquifer were nearly double the cap of 450,000 AFY, and various lawsuits were soon filed. In 2007 the legislature increased the cap to 572,000 AFY and mandated a stakeholder process to develop a plan to limit the takings of endangered species. The Edwards Aquifer Recovery Implementation Plan, announced in 2011, included $20 million for a water storage and recovery facility as well as about $10 million in payments to farmers and $5 million for a conservation program. Additional litigation led to new legislation that affirmed property ownership of groundwater with an exemption for the Edwards Aquifer (SB 332, 2012); however, a subsequent Texas Supreme Court decision (Edwards Aquifer Authority v. Day and McDaniel, 2012) established the principle that landowners could be compensated for loss of groundwater rights in the Edwards Aquifer area (Eckhardt, 2015). Although the creation of the Edwards Aquifer Authority improved the problem of excessive withdrawal from the aquifer, the law underlying the system of tradeable permits and the authority of the Edwards Aquifer Authority has continued to face challenges.

Sustainability Transition. To reduce dependence on the Edwards Aquifer, the city and its water utility have engaged in substantial WCP development, including outdoor watering restrictions with water police, assistance for landscape conversion, requirements for water-efficient appliances and plumbing fixtures, extensive water recycling, and a pricing policy based on increasing prices per unit as consumption increases. The city is nationally recognized as a leader in water-conservation efforts.

With respect to sustainability metrics, San Antonio's per capita water consumption fell from 225 gpcpd in 1982 to 121 gpcpd in 2014, and these efforts have allowed the city to limit aggregate demand that would otherwise have increased substantially because of population growth (San Antonio Water System, 2015). The city has a rank of 8 out of 197 cities in our comprehensive measure of WCP adoption, and it also has a high residual in our multivariate analysis; in other words, its actual WCP score was higher than predicted in comparison with other U.S. cities (Gilligan et al., 2017). We interpret this difference to be an effect of the strict limits placed on withdrawals from the Edwards Aquifer that motivated the WSO's conservation policies. As one SGO representative commented in an interviews, "San Antonio's water use was as inefficient as anyone's in this part of the world—Dallas or anywhere else—until they lost the Endangered Species Act lawsuit, and the federal court forced the Texas legislature to create a regulatory system for the aquifer."

Second-order Regime Conflicts. Our interviews indicated that support for WCPs is strong across various constituencies in the city and that there is good understanding of the necessity of high levels of water conservation. However, there was less consensus over the strategic issue of pursuing new water sources versus pursuing ongoing conservation. Various long-distance pipelines have also been approved or constructed to bring in water from more distant groundwater sources. Although these water-acquisition projects involve cooperative relations with other WSOs, the proposed developments have in some cases led to opposition. For example, the "Oppose the Hose" coalition of environmentalists, rural constituencies, and low-income urban constituencies sought to end the $2.4 billion Vista Ridge pipeline project. Interviewees from environmental organizations worried that the project would reduce political will in support of ongoing improvements in water conservation and aquifer recharging. In summary, a strong SGO and general recognition of limited water supplies has motivated a relatively strong sustainability transition for this city's WSO, but growth coalitions continue to advance projects associated with increased water acquisition, and advocates of demand reduction fear that these projects will lead to transition stasis.

4.5 Summary

Based on hydrological conditions alone, we would expect that the split in the four cases would be between the two Eastern and two Western cities, because Atlanta and Tampa are located in the wetter area of the country, and San Antonio and Phoenix are located in the drier area of the country. Although our multivariate analyses of our comprehensive measure of WCP adoption for 197 U.S. cities suggest that aridity is an important factor overall in the adoption of WCPs (Gilligan et al., 2017), the more fine-grained case studies presented here suggest that specific regional histories of water politics are needed to understand the conditions that affect the extent to which a sustainability transition is more or less advanced.

The Tampa and San Antonio cases are similar in several regards. Both are intrastate conflicts; both have high levels of measures for a sustainability transition; and both have a lower level of regime resistance than the comparison cities. In San Antonio and Tampa, the SGOs have the authority to regulate water-supply withdrawals, and the SGOS motivated the development of a strong portfolio of WCPs. Tampa Bay Water and the Edwards Aquifer Authority have significantly reduced water-related conflicts, have moved groundwater withdrawal in both regions toward safe yield goals, and have created the conditions for higher levels of WCP development. The state governments also had other SGOs in place to govern related issues such as water-supply development, regional water planning, and flood control.

In contrast, Atlanta and Phoenix have lower levels of WCP adoption, and in these cases there were also conflicts with neighboring states over surface water allocation. The interstate conflict is ongoing and intense for Atlanta but more historical for Phoenix because conflicts with neighboring state governments were settled through the Colorado River Compact and the subsequent Supreme Court decision. Phoenix has a high level of regime resistance, and Atlanta had substantial regime resistance from the landscaping industry and the urban growth coalition. The AMA in the Phoenix area has only weak authority to regulate groundwater withdrawal, but its role was largely irrelevant because most water for the city comes from the Salt River Project and the Central Arizona Project. Furthermore, because the AMA was imposed by the federal government and was not connected with the resolution of local water conflicts, it has lacked local support. Likewise, the Metropolitan North Georgia Water Planning District has relatively weak authority. It is primarily a planning entity, and authority for surface water allocation rested with federal courts and the Army Corps of Engineers.

5. Conclusions

Although our focus is on the regional scale and water-supply conflicts in the U.S., the framework developed for this study has broader implications for research on the politics of sustainability transitions for other industries and other spatial scales. Our primary contribution is to explore transition dynamics when attention is shifted from the niche-regime dynamic to the interactions among regime actors. We show that regime actor interactions are a source of organizational and technological innovation because the SGOs that emerge as solutions to the conflicts can help to spur the sustainability transition for the TS under their jurisdiction. However, the capacity for SGOs to motivate a strong sustainability transition depends on their scope of authority, on the level of resistance that emerges from the regime actors, and on resistance from affected actors associated with other industries (in our case especially landscapers and real estate developers).

Our comparative analysis also draws attention to two causal conditions that affect the formation of SGOs: conflicts among regime actors and the intervention of higher levels of government. Although cooperative relations could lead to the formation of SGOs, our cases do not provide evidence in support of this pathway, and instead there was protracted conflict that often led to years of court battles. To the extent that there was a resolution, it came from the courts and from higher levels of government authority.

Our analysis is limited in several ways, but these limitations open up questions for future research. For example, we focus on one spatial scale and one type of TS. As noted above, river systems that cross interstate or international boundaries have in some cases led to SGOs at higher levels of spatial scale. It is likely that the systematic analysis of SGOs across different levels of spatial scale and the interactions across scales would lead to additional insights into the causes and effects of SGOs. Likewise, we focus on one type of TS and do not explore SGOs for other industrial systems (e.g., energy, food, and transportation). In the U.S. there is a parallel world of SGOs for metropolitan transportation planning but no parallel history of SGO formation at the intrastate regional level for the electricity and telecommunications sectors. Instead, regulation for these sectors is largely accomplished through the public utilities commissions, which are part of state governments and have elected or appointed boards. It is possible that differences in the degree of embeddedness of a TS in a natural landscape may affect the likelihood of new SGO creation. The link to a natural landscape may be less important for modular communication systems such as cell phones and even long-distance electricity transmission than for a regional water-supply and transportation systems.

More generally, our analysis points to the benefits of decentering the analysis of the politics of transitions from the niche-regime relationship. Although by no means should that relationship be ignored, we are suggesting the value of drawing attention to the relations among regime actors. The regime actors include those from geographically proximate TSs in the same industry and those from economically proximate industries. Regime actor relationships interact with the niche-regime dynamic and therefore can affect the pace of a sustainability transition. By developing a processual model of SGO formation and its effects, we suggest one strategy for exploring the dynamic interaction of regime-regime and niche-regime relations. This approach promises to open up the emerging field of the politics of transitions to new complexities.

In turn, understanding these complexities may help advocates of enhanced sustainability for TSs like water supply to strategize better how to expand opportunities for sustainability transitions of these systems. We suggest that when SGOs are formed, it is important to define the mission broadly to include sustainability goals rather than to limit the mandate to solving immediate and pending problems such as water-supply shortages. We also suggest that in order for advocates of SGO formation to be successful at creating and maintaining an SGO, they need to identify the range of regime actors who are likely to resist the formation and development of the SGO, and advocates must then convince the regime actors that supporting the SGO will serve their long-term interests. Furthermore, advocates and policy entrepreneurs should search for opportunities to develop strategies to enroll higher-level governmental actors that can threaten to impose a settlement for the conflicts, and this strategy is especially important in situations where regime actors have mobilized against SGO formation or against SGO policies. Furthermore, the formation of the SGO does not end conflicts, and ongoing vigilance by transition coalitions is required. Our processual approach suggests that it is important to continue to monitor attempts by regime actors to undermine or weaken the SGO and instead to provide ongoing mobilization to support opportunities for the SGO to accomplish its goals.

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